

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claims 1 and 2 (Cancelled).

Claim 3 (Currently amended): A camera calibrating apparatus to be operative in combination with an imaging device which includes a housing unit and an optical section supported by said housing unit to obtain image information ~~thorough~~ through said optical section, and adapted to calibrate optical position information indicative of a position of said optical section, comprising:

first housing position information storing means for storing first housing position information indicative of a position of said housing unit in the first ~~co~~ordinate ~~ation~~ coordinate system in which a revising marker is located;

second housing position information storing means for storing second housing position information indicative of a position of said housing unit in the second ~~co~~ordinate ~~ation~~ coordinate system in which a calibrating marker is located;

first optical position information producing means for producing first optical position information indicative of a position of said optical section in said first ~~co~~ordinate ~~ation~~ coordinate system on the basis of said image information of said revising marker obtained by said imaging device;

first optical position information storing means for storing said first optical position information produced by said first optical position information producing means;

second optical position information producing means for producing second optical position information indicative of a position of said optical section to said second ~~co~~ordinate ~~ation~~ coordinate system from said second housing position information stored by said second housing position information storing means on the basis of said first housing position information stored by said first housing position information storing means and said first optical position information stored by said first optical position information storing means;

estimated ~~location~~ position information producing means for producing estimated ~~location~~ position information indicative of a position of said calibrating marker to an image ~~co~~ordinate ~~ation~~ coordinate system of said imaging device on the basis of said second optical position information produced by said second optical position information producing means;

second optical position information storing means for storing said second optical

position information produced by said second optical position information producing means;

estimated ~~location~~ position information storing means for storing said estimated ~~location~~ position information produced by said estimated ~~location~~ position information ~~estimating~~ producing means; and

calibrating means for calibrating said second optical position information stored by said second optical position information storing means on the basis of said image information of said calibrating marker obtained by said imaging device and said estimated ~~location~~ position information stored by said estimated ~~location~~ position information storing means.

Claim 4 (Currently amended): A camera calibrating apparatus as set forth in claim 3, in which said calibrating means includes:

image location information extracting means for extracting an image location information indicative of an image location of said calibrating marker to said image ~~coordination~~ coordinate system of said imaging device on the basis of said image information of said calibrating marker obtained by said imaging device;

calibration value calculating means for calculating a calibration value of said second optical position information stored by said second optical position information storing means on the basis of said image location information extracted by said image location information extracting means and said estimated ~~location~~ position information stored by said estimated ~~location~~ position information storing means; and

optical position information calibrating means for calibrating said second optical position information stored by said second optical position information storing means on the basis of said calibration value calculated by said calibration value calculating means.

Claim 5 (Original): A camera calibrating apparatus as set forth in claim 4, in which said calibrating means is adapted to calibrate a deviation of a rotational component of said second optical position information.

Claim 6 (Original): A camera calibrating apparatus as set forth in claim 4, in which

said image location information extracting means includes:

image displaying means for displaying an image of said calibrating marker obtained by said imaging device, and

image location specifying means for specifying said image location of said calibrating marker on said image of said calibrating marker displayed by said image displaying means and to ensure that said image location information is extracted.

Claim 7 (Currently amended): A camera calibrating apparatus as set forth in claim 4, in which said image location information extracting means includes:

estimated area information storing means for storing estimated area information indicative of said calibrating marker to said image ~~coordination~~ coordinate system of said imaging device; and

image location searching means for searching said image location of said calibrating marker from said image information of said calibrating marker obtained by said imaging device on the basis of said estimated area information stored by said estimated area information storing means and said estimated ~~location~~ position information stored by said estimated ~~location~~ position information storing means to ensure that said image location information is extracted.

Claim 8 (Currently amended): A camera calibrating apparatus to be operative in combination with an imaging device which includes a housing unit and an optical section supported by said housing unit to obtain image information ~~through~~ through said optical section, and adapted to calibrate optical position information ~~inductive~~ indicative of a position of said optical section, comprising:

first housing position information storing means for storing first housing position information indicative of a position of said housing unit in the first ~~coordination~~ coordinate system in which a revising marker is located;

second housing position information storing means for storing second housing position information indicative of a position of said housing unit in the second ~~coordination~~ coordinate system;

first optical position information producing means for producing first optical position information indicative of a position of said optical section in said first ~~coordination~~ coordinate system on the basis of said image information obtained by said imaging device and indicative of said revising marker;

first optical position information storing means for storing said first optical position information produced by said first optical position information producing means;

second optical position information producing means for producing second optical position information indicative of a position of said optical section to said second ~~coordination~~ coordinate system from said second housing position information stored by said second housing position information storing means on the basis of said first housing position information stored by said first housing position information storing means and said first optical position information stored by said first optical position information storing means;

second optical position information storing means for storing said second optical position information produced by said second optical position information producing means; and
calibrating means for calibrating said second optical position information stored by said second optical position information storing means on the basis of a motion vector of said image information obtained by said imaging device in said second ~~coordination~~ coordinate system.

Claim 9 (Currently amended): A camera calibrating apparatus as set forth in claim 8, in which said calibrating means includes:

plane-projected image producing means for producing a plane-projected image from said image information obtained by said imaging device in said second ~~coordination~~ coordinate system;

plane-projected image dividing means for dividing said plane-projected image produced by said plane-projected image producing means into a plurality of image segments;

motion vector extracting means for extracting said motion vector from said image segments divided by said plane-projected image dividing means;

calibration value calculating means for calculating a calibration value of said second optical position information stored by said second optical position information storing means on the basis of said motion vector extracted by said motion vector extracting means; and

optical position information calibrating means for calibrating said second optical position information stored by said second optical position information storing means on the basis of said calibration value calculated by said calibration value calculating means.

Claim 10 (Currently amended): A camera calibrating apparatus as set forth in claim 9, in which

a dividing marker is located in said second ~~coordination~~ coordinate system in a predetermined relationship with said position of said housing unit represented by said second position information stored by said second position information storing means, and in which

plane-projected image dividing means is adapted to divide said plane-projected image produced by said plane-projected image producing means into a plurality of image segments on the basis of said image information of said dividing marker obtained by said imaging device.

Claim 11 (Currently amended): A camera calibrating apparatus to be operative in combination with an imaging device which includes a housing unit and an optical section supported by said housing unit to obtain image information ~~through~~ through said optical section, and adapted to calibrate position information of said optical section, comprising:

first housing position information storing means for storing first housing position information indicative of a position of said housing unit in the first ~~eeordination~~ coordinate system in which a revising marker is located;

second housing position information storing means for storing second housing position information indicative of a position of said housing unit in the second ~~eeordination~~ coordinate system in which an automotive vehicle is located;

first optical position information producing means for producing first optical position information indicative of a position of said optical section in said first ~~eeordination~~ coordinate system on the basis of said image information of said revising marker obtained by said imaging device;

first optical position information storing means for storing said first optical position information produced by said first optical position information producing means;

second optical position information producing means for producing second optical position information indicative of a position of said optical section to said second ~~eeordination~~ coordinate system from said second housing position information stored by said second housing position information storing means on the basis of said first housing position information stored by said first housing position information storing means and said first optical position information stored by said first optical position information storing means;

estimated ~~location~~ position information producing means for producing estimated ~~location~~ position information indicative of a position of said automotive vehicle to an image ~~eeordination~~ coordinate system of said imaging device on the basis of said second optical position information produced by said second optical position information producing means;

second optical position information storing means for storing said second optical position information produced by said second optical position information producing means;

estimated ~~location~~ position information storing means for storing said estimated ~~location~~ position information produced by said estimated ~~location~~ position information estimating means; and

calibrating means for calibrating said second optical position information stored by said second optical position information storing means on the basis of said image information of said automotive vehicle obtained by said imaging device and said estimated ~~location~~ position information stored by said estimated ~~location~~ position information storing means.

Claim 12 (Currently amended): A camera calibrating apparatus as set forth in claim 11, in which

said calibrating means includes:

image location information extracting means for extracting an image location information indicative of an image location of said automotive vehicle in said image ~~coordination~~ coordinate system of said imaging device on the basis of said image information of said automotive vehicle obtained by said imaging device;

calibration value calculating means for calculating a calibration value of said second optical position information stored by said second optical position information storing means on the basis of said image location information extracted by said image location information extracting means and said estimated ~~location~~ position information stored by said estimated ~~location~~ position information storing means; and

optical position information calibrating means for calibrating said second optical position information stored by said second optical position information storing means on the basis of said calibration value calculated by said calibration value calculating means.

Claim 13 (Currently amended): A camera calibrating apparatus as set forth in claim 12, in which

said calibration value calculating means includes:

superimposing means for superimposing a profile line of said automotive vehicle represented by said image location information on a profile line of said automotive vehicle represented by said estimated ~~location~~ position information;

extracting means for extracting a plurality of points from said overlapped profile lines of said automotive vehicle superimposed by said superimposing means, and

calculating means for calculating a calibration value of said second optical position information by comparing said points of said image location information with said points of said estimated ~~location~~ position information.

Claim 14 (Currently amended): A camera calibrating apparatus as set forth in any one of claims ~~[[1]]~~ 3 to 13, in which said imaging device is mounted on an automotive vehicle.

Claim 15 (Currently amended): An imaging system comprises a camera calibrating apparatus as set forth in any one of claims 1 to ~~[[14]]~~ 13.

Claim 16 (Currently amended): An imaging control system comprises a camera calibrating apparatus as set forth in any one of claims 1 to ~~[[14]]~~ 13.

Claims 17 and 18 (Cancelled):

Claim 19 (Currently amended): A camera calibrating method of calibrating optical position information ~~inductive~~ indicative of a position of an optical section supported by a housing unit of a camera for obtaining image information through said optical section, comprising:

a first housing position information storing step of storing first housing position information indicative of a position of said housing unit in the first ~~coordination~~ coordinate system in which a revising marker is located;

a second housing position information storing step of storing second housing position information indicative of a position of said housing unit in the second ~~coordination~~ coordinate system in which a calibrating marker is located;

a first optical position information producing step of producing first optical position information indicative of a position of said optical section in said first ~~coordination~~ coordinate system on the basis of said image information of said revising marker obtained by said imaging device;

a first optical position information storing step of storing said first optical position information produced in said first optical position information producing step;

a second optical position information producing step of producing second optical position information indicative of a position of said optical section to said second ~~coordination~~ coordinate system from said second housing position information stored in said second housing position information storing step on the basis of said first housing position information stored in said first housing position information storing step and said first optical position information stored in said first optical position information storing step;

an estimated ~~location~~ position information producing step of producing estimated ~~location~~ position information indicative of a position of said calibrating marker to an image ~~coordination~~ coordinate system of said imaging device on the basis of said second optical position information produced in said second optical position information producing step;

a second optical position information storing step of storing said second optical position information produced in said second optical position information producing step;

an estimated ~~location~~ position information storing step of storing said estimated ~~location~~ position information produced in said estimated ~~location~~ position information estimating step;
and

a calibrating step of calibrating said second optical position information stored in said second optical position information storing step on the basis of said image information of said calibrating marker obtained by said imaging device and said estimated ~~location~~ position information stored in said ~~estimated location~~ position information storing step.

Claim 20 (Currently amended): A camera calibrating method of calibrating optical position information ~~inductive~~ indicative of a position of an optical section supported by a housing unit of a camera for obtaining image information through said optical section, comprising:

- a first housing position information storing step of storing first housing position information indicative of a position of said housing unit in the first ~~coordination~~ coordinate system in which a revising marker is located;

- a second housing position information storing step of storing second housing position information indicative of a position of said housing unit in the second ~~coordination~~ coordinate system;

- a first optical position information producing step of producing first optical position information indicative of a position of said optical section in said first ~~coordination~~ coordinate system on the basis of said image information obtained by said imaging device and indicative of said revising marker;

- a first optical position information storing step of storing said first optical position information produced in said first optical position information producing step;

- a second optical position information producing step of producing second optical position information indicative of a position of said optical section to said second ~~coordination~~ coordinate system from said second housing position information stored in said second housing position information storing step on the basis of said first housing position information stored in said first housing position information storing step and said first optical position information stored in said first optical position information storing step;

- a second optical position information storing step of storing said second optical position information produced in said second optical position information producing step; and

- a calibrating step of calibrating said second optical position information stored in said second optical position information storing step on the basis of a motion vector of said image information obtained by said imaging device in said second ~~coordination~~ coordinate system.

Claim 21 (Currently amended): A camera calibrating method of calibrating optical position information ~~inductive~~ indicative of a position of an optical section supported by a housing unit of a camera for obtaining image information through said optical section, comprising:

- a first housing position information storing step of storing first housing position information indicative of a position of said housing unit in the first ~~coordination~~ coordinate system in which a revising marker is located;

- a second housing position information storing step of storing second housing position

information indicative of a position of said housing unit in the second ~~eeordination~~ coordinate system in which an automotive vehicle is located;

a first optical position information producing step of producing first optical position information indicative of a position of said optical section in said first ~~eeordination~~ coordinate system on the basis of said image information of said revising marker obtained by said imaging device;

a first optical position information storing step of storing said first optical position information produced in said first optical position information producing step;

a second optical position information producing step of producing second optical position information indicative of a position of said optical section to said second ~~eeordination~~ coordinate system from said second housing position information stored in said second housing position information storing step on the basis of said first housing position information stored in said first housing position information storing step and said first optical position information stored in said first optical position information storing step;

an estimated ~~location~~ position information producing step of producing estimated ~~location~~ position information indicative of a position of said automotive vehicle to an image ~~eeordination~~ coordinate system of said imaging device on the basis of said second optical position information produced in said second optical position information producing step;

a second optical position information storing step of storing said second optical position information produced in said second optical position information producing step;

an estimated ~~location~~ position information storing step of storing said estimated ~~location~~ position information produced in said estimated ~~location~~ position information estimating step;
and

a calibrating step of calibrating said second optical position information stored in said second optical position information storing step on the basis of said image information of said automotive vehicle obtained by said imaging device and said estimated ~~location~~ position information stored in said estimated ~~location~~ position information storing step.

Claim 22 (Currently amended): A camera calibrating method as set forth in any one of claims [[17]] 19 to 21, in which said imaging device is mounted on an automotive vehicle.

Claims 23 to 27 (Cancelled).